PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-260145

(43)Date of publication of application : 03.10.1997

(51)Int.Cl. H01F 19/00
H01F 17/00

(21)Application number : 08-066589

(22)Date of filing : 22.03.1996

(71)Applicant : MURATA MFG CO LTD

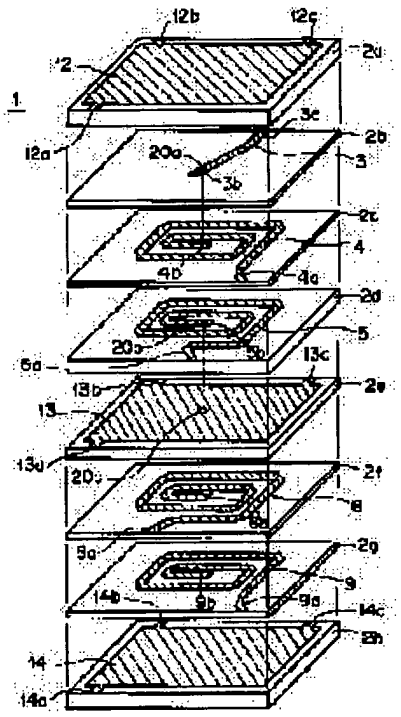
(72)Inventor : MORIKAWA NAGAHIKO

(54) LAYER-BUILT BALUN TRANSFORMER

(57)Abstract:

PROBLEM TO BE SOLVED: To adjust electromagnetic couplings between strip lines easily and, further, reduce the size.

SOLUTION: A layer-built balun transformer 1 is composed of a dielectric sheet 2b which has extraction electrode 3 on its surface, dielectric sheets 2c, 2d, 2f and 2g which have 1/4-wavelength strip lines 4, 5, 8 and 9 on their surfaces respectively and dielectric sheets 2a, 2e and 2h which have grounding electrodes 12, 13 and 14 on their surfaces respectively. The strip lines 4 and 5 are made to face each other with the sheet 2c therebetween to form an electromagnetic coupling. The strip lines 8 and 9 are made to face each other with the sheet 2f therebetween to form an electromagnetic coupling. The end part 4a of the strip line 4 and the end part 9a of the strip line 9 are electrically connected to each other through external electrodes.



LEGAL STATUS

[Date of request for examination] 14.01.1997

[Date of sending the examiner's decision of rejection] 11.05.1999

[Kind of final disposal of application other than

the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2990652
[Date of registration]	15.10.1999
[Number of appeal against examiner's decision of rejection]	11-09588
[Date of requesting appeal against examiner's decision of rejection]	10.06.1999
[Date of extinction of right]	

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a laminating mold balloon transformer and the laminating mold balloon transformer especially used as balanced - unbalance signal converter thru/or a phase transducer, etc. of IC for radio devices.
[0002]
[Description of the Prior Art] A balloon transformer is for changing the balanced signal of a balanced transmission line (balance transmission line), and the unbalance signal of the unbalance transmission line (imbalance transmission line) mutually, and a balloon is the abbreviated name of balance-imbalance. A balanced transmission line is equipped with two signal-line ways which make a pair, and what a signal (balanced signal) spreads as the potential difference between two signal-line ways is said. In a balanced transmission line, since an outpatient department noise influences equally to two signal-line ways, an outpatient department noise is offset and there is an advantage of being hard to be influenced of an outpatient department noise. Moreover, since the circuit inside an analog IC consists of differential amplifier, it is a balance mold with which the input/output terminal for the signals of an analog IC also inputs or outputs a signal as the potential difference between two terminals in many cases. On the other hand, that to which a signal (unbalance signal) spreads the unbalance transmission line as potential of the one transmission line to ground potential (zero potential) is said, for example, the microstrip line on a coaxial track or a substrate is equivalent to this.
[0003] Conventionally, the balloon transformer of the structure which carried out the bifilar wound of the coil to magnetic-substance cores, such as a ferrite, was used as a balanced - unbalance transducer of the transmission line in a RF circuit. However, in the high frequency band for example, more than a UHF band, the balloon transformer of this structure had large conversion loss, and there was a limitation also in a miniaturization. To such a frequency band, the balloon transformer 51 of the coaxial structure shown in drawing 6 was used. This balloon transformer 51 has a center electrode 55, and input/output terminal 52a is connected to the end of a center electrode 55. The other end of a center electrode 55 is opened wide. It is prepared in the perimeter of a center electrode 55 so that two internal electrodes 56a and 56b may carry out an electromagnetic coupling to a center electrode 55. The inside edge where two internal electrodes 56a and 56b counter is connected to other two input/output terminals 52b and 52c through leader lines 57a and 57b, respectively. Furthermore, a dielectric is inserted into the perimeter of two internal electrodes 56a and 56b, and the grand electrode 58 is formed in it. The both ends of the grand electrode 58 are connected to the edge of the outside of internal electrodes 56a and 56b.
[0004] Moreover, the laminating mold balloon transformer 60 independently indicated to be this to drawing 7 is also proposed. This balloon transformer 60 consists of dielectric layer 61b which formed the cash-drawer electrode 62 in the front face, dielectric layer 61c which formed the 1/2-wave stripline 63 in the front face, 61d of dielectric layers which formed the quarter-wave length striplines 64 and 65 in the front face, dielectric layers 61a and 61e which formed the grand electrodes 66 and 67 in the front face, respectively. Striplines 64 and 65 are carrying out the electromagnetic coupling to left-

hand side section 63a of a stripline 63, and right-hand side section 63b, respectively.
[0005]
[Problem(s) to be Solved by the Invention] However, if it was in the former balloon transformer 51, since it had coaxial structure, the miniaturization was unsuitable to the device as which a small balloon transformer is required like a mobile radio machine difficult. Moreover, when this balloon transformer 60 was mounted in a printed circuit board etc. since the 1/2-wave stripline 63 was taken about on same dielectric layer 61c although miniaturized to be sure as compared with the balloon transformer 51 of coaxial structure if it was in the latter balloon transformer 60, there was a problem that the area occupied on a printed circuit board was large.
[0006] Moreover, when adjusting the electrical characteristics of the balloon transformer 60, the Rhine width of face of the thickness of a dielectric layer or a stripline is changed, and the electromagnetic coupling between striplines is adjusted. However, in order to have adjusted independently the electromagnetic coupling between left-hand side section 63a of the stripline 64-stripline 63 to the electromagnetic coupling between right-hand side section 63b of the stripline 65-stripline 63, the Rhine width of face of left-hand side section 63a of a stripline 64 or a stripline 63 had to be changed and adjusted, for example. It is because the electromagnetic coupling between right-hand side section 63b of the stripline 65-stripline 63 will also be affected if the thickness of dielectric layer 61c inserted into striplines 64 and 65 and a stripline 63 is changed. Being able to perform only slight adjustment only by adjustment by this Rhine width of face, adjustment of the electromagnetic coupling between striplines was not easy.
[0007] Then, the purpose of this invention is to offer the laminating mold balloon transformer which can adjust the electromagnetic coupling between striplines easily, and can attain a miniaturization.
[0008]
[Means for Solving the Problem] In order to attain the above purpose, the laminating mold balloon transformer concerning this invention has at least 2 sets of striplines of the pair which carries out an electromagnetic coupling through a dielectric layer, and is characterized by accumulating 2 sets of these striplines through a dielectric layer. Moreover, the laminating mold balloon transformer concerning this invention (a) The 1st dielectric sheet which prepared the 1st stripline in the front face, (b) The 2nd dielectric sheet which prepared said 1st stripline and the 2nd stripline which carries out an electromagnetic coupling in the front face, (c) The 3rd dielectric sheet which prepared the 3rd stripline in the front face, (d) The 4th dielectric sheet which prepared said 3rd stripline and the 4th stripline which carries out an electromagnetic coupling in the front face, (e) It is characterized by having an electrical connecting means for connecting electrically said 1st stripline prepared in the layered product which accumulated and constituted the said 1st, 2nd, 3rd, and 4th dielectric sheets, and said 4th stripline. There is a beer hall prepared here as an electrical connecting means the external electrode prepared, for example in the side face of a layered product or inside the layered product.
[0009]
[Function] Without juxtaposing each stripline on the same dielectric layer, it will be put through a dielectric layer by the above configuration, and becomes the balloon transformer of ****** by it. Furthermore, the dielectric layer thickness inserted between the striplines of the pair which carries out an electromagnetic coupling is also adjusted

independently with the dielectric layer pinched between the striplines of other pairs.
[0010]
[Embodiment of the Invention] Hereafter, the operation gestalt of the laminating mold balloon transformer concerning this invention is explained with reference to an accompanying drawing. In each operation gestalt, the same sign was given to the same components and the same part.
As shown in [1st operation gestalt, drawing 1 - drawing 3] drawing 1 , the laminating mold balloon transformer consists of dielectric sheet 2b which formed the cash-drawer electrode 3 in the front face, dielectric sheets 2c, 2d, 2f, and 2g which formed the quarter-wave length striplines 4, 5, 8, and 9, respectively, dielectric sheets 2a, 2e, and 2h which formed the grand electrodes 12, 13, and 14 in the front face, respectively.
[0011] Resin or ceramic dielectrics, such as epoxy, etc. are used as a dielectric sheets [2a-2h] ingredient. With the 1st operation gestalt, what made what kneaded dielectric ceramic powder with the binder etc. the shape of a sheet as a dielectric sheets [2a-2h] ingredient was used. One edge 3a exposes the cash-drawer electrode 3 to the location of center-section rightist inclinations of the side by the side of the back of sheet 2b, and other-end section 3b is located in the center section of sheet 2b. The quarter-wave length stripline 4 is carrying out the spiral configuration, one edge 4a is exposed to the right-hand side of the side of the near side of sheet 2c, and other-end section 4b is located in the center section of sheet 2c. Other-end section 4b of a stripline 4 is electrically connected to other-end section 3b of the cash-drawer electrode 3 through beer hall 20a prepared in sheet 2b. The spiral configuration is carried out, it exposes to the center-section S twist of the side of a near side one edge 5a of whose is sheet 2d, and the quarter-wave length stripline 5 is located in the center section whose other-end section 5b is sheet 2d. This stripline 5 is formed so that a stripline 4 may be countered on both sides of sheet 2c. Therefore, the electromagnetic coupling of the striplines 4 and 5 is carried out, and they constitute a coupler.
[0012] The spiral configuration is carried out, it exposes to the center-section left of the side of a near side one edge 8a of whose is sheet 2f, and the quarter-wave length stripline 8 is located in the center section whose other-end section 8b is sheet 2f. The stripline 9 of quarter-wave length is carrying out the spiral configuration, and exposes it to the right-hand side of the side of a near side one edge 9a of whose is sheet 2g, and other-end section 9b is located in a sheet 2g center section, and is opened wide. This stripline 9 is formed so that a stripline 8 may be countered on both sides of sheet 2f. Therefore, the electromagnetic coupling of the striplines 8 and 9 is carried out, and they constitute a coupler.
[0013] The grand electrode 12 was formed all over the abbreviation for sheet 2a, and exposed the cash-drawer section 12a to the left-hand side of the side of the near side of sheet 2a, and the cash-drawer sections 12b and 12c have exposed it to the neighboring left-hand side and the right-hand side by the side of the back of sheet 2a, respectively. The grand electrode 13 was formed all over the abbreviation for sheet 2e, and exposed the cash-drawer section 13a to the left-hand side of the side of the near side of sheet 2e, and the cash-drawer sections 13b and 13c have exposed it to the neighboring left-hand side and the right-hand side by the side of the back of sheet 2e, respectively. The grand electrode 13 is electrically connected to edge 8b of a stripline 8 through beer hall 20c which connected with edge 5b of a stripline 5 electrically through beer hall 20b prepared

in sheet 2d, and was prepared in sheet 2e. The grand electrode 14 was formed all over the abbreviation for sheet 2h, and exposed the cash-drawer section 14a to the left-hand side of the side of a sheet 2h near side, and the cash-drawer sections 14b and 14c have exposed it to the neighboring left-hand side and the right-hand side by the side of the sheet 2h back, respectively.

[0014] As for these grand electrodes 12-14, it is desirable to be arranged in consideration of the property of the balloon transformer 1 in the location which only a predetermined distance separated from striplines 4, 5, 8, and 9. The cash-drawer electrode 3, striplines 4, 5, 8, and 9, and the grand electrodes 12-14 are formed by approaches, such as the sputtering method, vacuum deposition, and print processes, and consist of ingredients, such as Ag-Pd, and Ag, Pd, Cu.

[0015] Each sheets 2a-2h are accumulated, and by being calcinated in one, as shown in drawing 2 , let them be layered products 20. The external electrodes 25, 26, 27, and 28 are formed in the side face of the near side of a layered product 20, and the external electrodes 29, 30, 31, and 32 are formed in the side face by the side of the back. The external electrodes 25-32 are formed by approaches, such as the sputtering method, vacuum deposition, and print processes, and consist of ingredients, such as Ag-Pd, and Ag, Pd, Cu.

[0016] The external electrode 25 for glands is electrically connected to the cash-drawer sections 12a-14a of the grand electrodes 12-14. The external electrode 26 for I/O is electrically connected to edge 8a of a stripline 8. The external electrode 27 for I/O is electrically connected to edge 5a of a stripline 5. The external electrode 28 for junction is electrically connected to the edges 4a and 9a of striplines 4 and 9. The external electrode 29 for glands is electrically connected to the cash-drawer sections 12b-14b of the grand electrodes 12-14. I/O -- business -- the external electrode 31 is electrically connected to edge 3a of the cash-drawer electrode 3 -- having -- a gland -- business -- the external electrode 32 is electrically connected to the cash-drawer sections 12c-14c of the grand electrodes 12-14. Drawing 3 is the electric representative circuit schematic of the balloon transformer 1.

[0017] Since the balloon transformer 1 which consists of the above configuration has set the die length of each striplines 4, 5, 8, and 9 as one fourth of the wavelength of application center frequency, it does not need the dielectric sheet of a big area. Consequently, this balloon transformer 1 can realize a miniaturization. Specifically, the balloon transformer 1 can hold down the area occupied to a printed circuit board etc. to abbreviation 1/2 as compared with the conventional laminating mold balloon transformer 60 shown in drawing 7 .

[0018] Moreover, when adjusting the electrical characteristics of the balloon transformer 1, the electromagnetic coupling between striplines 4 and 5 or the electromagnetic coupling between striplines 8 and 9 is adjusted by changing dielectric sheets [2c and 2f] thickness and the Rhine width of face of striplines 4, 5, 8, and 9. Especially each striplines 4, 5, 8, and 9 are not formed on the same dielectric sheet, but the electromagnetic coupling of the striplines 4 and 5 is carried out through dielectric sheet 2c, and they are carrying out the electromagnetic coupling of the striplines 8 and 9 through dielectric sheet 2f. Therefore, the electromagnetic coupling between striplines 8 and 9 can adjust independently the electromagnetic coupling between striplines 4 and 5 by changing dielectric sheets [2c and 2f] thickness according to an individual,

respectively. Consequently, the balloon transformer 1 which can adjust the electromagnetic coupling between striplines easily is obtained.

[0019] Moreover, since the grand electrode 12 is formed in the top face, the balloon transformer 1 has a shielding effect. In addition, although the grand electrode 12 is exposed to a top face, it cannot be overemphasized that you may make it cover this grand electrode 12 in one with other dielectric sheets. Furthermore, the case where this balloon transformer 1 is used as a balanced - unbalance signal converter is explained. In order to change the unbalance signal of the unbalance transmission line, and the balanced signal of a balanced transmission line mutually, the unbalance transmission line is connected to the external electrode 31, and a balanced transmission line is connected to the external electrodes 26 and 27, respectively. And the unbalance signal which has spread the unbalance transmission line is the external electrode 31. - It spreads with the cash-drawer electrode 3-stripline 4-external electrode 28-stripline 9. And by carrying out an electromagnetic coupling to a stripline 5 in a stripline 4, and carrying out an electromagnetic coupling to a stripline 8 in a stripline 9, an unbalance signal is changed into a balanced signal and this balanced signal is taken out between two signal-line ways of a balanced transmission line through the external electrodes 26 and 27. By the balanced signal between two signal-line ways of a balanced transmission line going into the balloon transformer 1 through the external electrodes 26 and 27, and on the other hand, performing the above-mentioned operation conversely, a balanced signal is changed into an unbalance signal and this unbalance signal is taken out by the unbalance transmission line through the external electrode 31.

[0020] In the balloon transformer 1 of the 1st operation gestalt, the balloon transformer of the 2nd operation gestalt of [the 2nd operation gestalt, drawing 4 , and drawing 5] is the same as that of what used the beer hall instead of the external electrode, in order to connect two striplines 4 and 9 electrically. The quarter-wave length stripline 36 prepared in the front face of dielectric sheet 2c is carrying out the spiral configuration, one edge 36a is located in the right-hand side of the side of the near side of sheet 2c, and other-end section 36b is located in the center section of sheet 2c. The quarter-wave length stripline 39 prepared in the dielectric sheet 2g front face is carrying out the spiral configuration, and one edge 39a is located in the right-hand side of the side of a sheet 2g near side, and it is located in the center section whose other-end section 39b is sheet 2g.

[0021] Beer halls 41a, 41b, 41c, and 41d are established in the dielectric sheets 2c, 2d, 2e, and 2f, respectively, and edge 36a of a stripline 36 and edge 39a of a stripline 39 are electrically connected through these beer halls 41a-41d. And in addition to the cash-drawer sections 12a-14c, the grand electrodes 12, 13, and 14 are provided so that the cash-drawer sections 12d, 13d, and 14d may be further exposed to the right-hand side of the side of a Sheets [2a, 2e, and 2h] near side, respectively.

[0022] Each sheets 2a-2h are accumulated, and by being calcinated in one, as shown in drawing 5 , let them be layered products 42. The external electrodes 43, 44, 45, and 46 are formed in the side face of the near side of a layered product 42, and the external electrodes 47, 48, 49, and 50 are formed in the side face by the side of the back. The external electrode 43 for glands is electrically connected to the cash-drawer sections 12a-14a of the grand electrodes 12-14. The external electrode 44 for I/O is electrically connected to edge 8a of a stripline 8. The external electrode 45 for I/O is electrically connected to edge 5a of a stripline 5. The external electrode 46 for glands is electrically

connected to 12d - 14d of cash-drawer sections of the grand electrodes 12-14. The external electrode 47 for glands is electrically connected to the cash-drawer sections 12b-14b of the grand electrodes 12-14. I/O -- business -- the external electrode 49 is electrically connected to edge 3a of the cash-drawer electrode 3 -- having -- a gland -- business -- the external electrode 50 is electrically connected to the cash-drawer sections 12c-14c of the grand electrodes 12-14. The balloon transformer 35 which consists of the above configuration does so the same operation effectiveness as the balloon transformer 1 of said 1st operation gestalt.

[0023] operation gestalt] besides [-- in addition, the laminating mold balloon transformer concerning this invention is not limited to said operation gestalt, within the limits of the summary, can be boiled variously and can be changed. The configuration of a stripline is arbitrary, and is spiral, and also it may be a letter of meandering. Moreover, it is not necessary to necessarily set a stripline as the die length of quarter-wave length, and does not need to be set as a dimension with all striplines equal [the Rhine width of face].

[0024] moreover, said operation gestalt -- an individual -- although the case of a product was made into the example and explained, the mother substrate which equipped the case at the time of mass production with two or more balloon transformers of a part can be manufactured, and it can start in desired size, and can consider as a product. Although said operation gestalt is calcinated in one after it accumulates the dielectric sheet with which the conductor was formed, it is not necessarily limited to this. A sheet may use what was calcinated beforehand. Moreover, a balloon transformer may be manufactured by the process explained below. After applying paste-like dielectric materials with means, such as printing, and forming a dielectric layer, a paste-like conductor ingredient is applied to the front face of the dielectric layer, and the conductor of arbitration is formed in it. Next, paste-like dielectric materials are applied from said conductor. In this way, the balloon transformer which has a laminated structure is obtained by giving two coats in order.

[0025]

[Effect of the Invention] Without juxtaposing each stripline on the same dielectric layer, since it has at least 2 sets of striplines of the pair which carries out an electromagnetic coupling through a dielectric layer according to this invention so that clearly by the above explanation and 2 sets of these striplines are accumulated through the dielectric layer, a laminating will be carried out through a dielectric layer and it becomes the balloon transformer of ******. Furthermore, the laminating mold balloon transformer which can adjust independently the dielectric layer thickness inserted between the strips of the pair which carries out an electromagnetic coupling with the dielectric layer into which it was inserted between the striplines of other pairs, and can adjust the electromagnetic coupling between striplines easily can be obtained.

[Translation done.]